REMARKS/ARGUMENTS

The claims have been amended better to point out that which Applicants regard as their invention and to overcome the rejection under the second paragraph of 35 U.S.C. §112. A new Claim 18 depending from Claim 12 has been added. The claims before the Examiner are Claims 12-18.

The rejection of Claims 12-17 under the first paragraph of 35 U.S.C. §112 as failing to comply with the written description requirement is noted. Enclosed herewith is an English translation of the Japanese Industrial Standard mentioned in the specification for measurement of strength properties, hardness, and impact resilience.

The rejection of Claims 13-17 under the second paragraph of 35 U.S.C. §112 is addressed by having those claims depend from Claim 12. The comment that the molecular weight of the low molecular weight diol is considered to be no greater than 250 is noted. Applicants point out that the disclosure refers to a preferred embodiment.

The rejection of Claims 12-17 under 35 U.S.C. §102 as anticipated by Vedula et al. '059, if applied to the claims as amended, is respectfully traversed.

Claim 12 has been amended to restrict the number average molecular weight of the high molecular weight diol to a range of 1,000 to 2,000 and the first two members of the Markush group identifying the high molecular weight diols, namely polytetramethylene ether glycol and polybutylene adipate diol, have been canceled. A new Claim 18 directed to a golf ball in which the cover comprises a thermoplastic polyurethane according to Claim 12 is also before the Examiner for consideration.

Vedula et al. '059 describes a thermoplastic polyether polyurethane formed from a reaction involving a hydroxyl terminal polyether with a weight average molecular weight of at least 1,400. The high molecular weight diol recited in Claim 12 is restricted to polycarbonate diols, polysiloxane diols and mixtures thereof. The reference does not teach

on suggest high molecular weight diols recited in the amended claims. Thus, the claims patentably define over the disclosure in Vedula et al. '059.

Applicants also respectfully point out that the polymers of the reference and the present claims are different in the sense that the reference discloses the use of the thermoplastic polyether polyurethane as a core for a golf ball but not as a cover for a golf ball as described in the present application. The characteristics and properties of a golf ball core and a golf ball cover are different and the impact resistance values of the present claims are intended to show the usefulness of the claimed material as a golf ball cover. The thermoplastic polyurethanes of the present invention have both high impact resistance and a resistance to changes in impact resistance as temperature changes. Such properties, shown in the working and comparative examples in Table 1 and 2 on pages 20 and 24 respectively, are nowhere taught or suggested in the reference. The rejection should be withdrawn.

The Examiner is thanked for acknowledging receipt of copy of the certified copies of priority documents from the International Bureau and for listing references provided with Information Disclosure Statements.

In view of the foregoing revisions and remarks, it is respectfully submitted that the application is in condition for allowance and a U.S. PTO paper to those ends is earnestly solicited. The Examiner is requested to telephone the undersigned should additional changes be required in the case prior to allowance.

Respectfully submitted,

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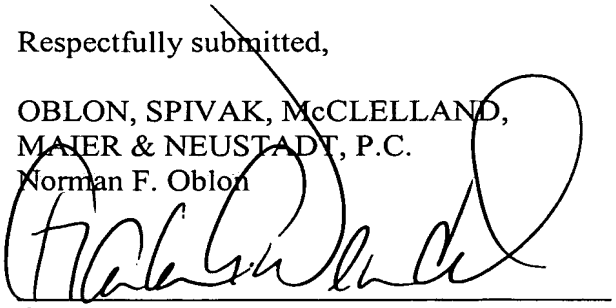
Norman F. Oblon



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JIS

JAPANESE INDUSTRIAL STANDARD

Translated and Published by
Japanese Standards Association

JIS K 7311 : 1995

Testing methods for thermoplastic polyurethane elastomers

ICS 83.080.20

Descriptors : elastomers, polyurethane, thermoplasticity, mechanical testing

Reference number : **JIS K 7311 : 1995 (E)**

Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of International Trade and Industry through deliberations at Japanese Industrial Standards Committee in accordance with the Industrial Standardization Law:

Date of Establishment: 1987-01-01

Date of Revision: 1995-12-01

Date of Public Notice in Official Gazette: 1995-12-01

Investigated by: Japanese Industrial Standards Committee
Divisional Council on High Molecular Materials

JIS K 7311:1995, First English edition published in 2000-04

Translated and published by: Japanese Standards Association
4-1-24, Akasaka, Minato-ku, Tokyo, 107-8440 JAPAN

In the event of any doubts arising as to the contents, the original JIS is to be the final authority.

Testing Methods for Thermoplastic Polyurethane Elastomers

1. Scope

This Japanese Industrial Standard specifies the testing methods for thermoplastic polyurethane elastomers.

Remarks: In this standard the units and numerical values in { } are in accordance with the conventional system of units and are appended for informative reference.

2. Test Items

The test items specified in this standard shall be as follows.

(1) Specific gravity test

(2) Tension test

(3) Tear test

(4) Hardness test

(5) Impact resilience test

(6) Abrasion test

(7) Flow test

Normative references and related Standards: See last page of this text.

3. General Conditions for Test

3.1 Standard Condition of Laboratory The standard condition of laboratory shall be, as a rule, the Grade 2 of standard temperature condition (23 ± 2°C) and the Grade 2 of standard humidity condition (50 ± 5 %) specified in JIS K 7100.

3.2 Preparatory Conditioning Time for Sample The sample shall be submitted to the test after the preparatory conditioning for 88 h or over under the standardized condition in the laboratory specified in 3.1 after forming. In this case, other conditioning may be carried out in accordance with the agreement betwen the parties concerned.

3.3 Sample for Preparation of Test Pieces Principally, the test pieces shall be taken from the plate-type sample which is formed as at least 100 mm x 100 mm in size and 2 to 3 mm in thickness by means of an injection molding. When preparing test pieces, it shall be avoided to take the test pieces near the gate of the injection molding.

The injection molding shall be carried out under suitable conditions according to the type and grade of the elastomer to be tested.

3.4 Rounding off of Test Results The test results obtained at each test shall be rounded-off according to JIS Z 8401, and be represented by the number of figures specified in Table 1.

Table 1. Rounding-off of Test Results

Measuring items		Test results to be obtained
Specific gravity		Three significant figures
Tensile strength	MPa {kgf/cm²}	One decimal place whole number
Elongation	%	Two significant figures
Tensile stress	MPa {kgf/cm²}	One decimal place whole number
Tear strength	kN/m {kgf/cm}	One decimal place whole number
Hardness		Whole number
Impact resilience	%	Whole number
Abrasion loss	mg	Whole number
Flow value	cm³/s	Two significant figures

4. Specific Gravity Test

4.1 Test Piece Test pieces shall be prepared from the sample specified in 3.3 by means of cutting into the size suitable for the beaker or water vessel used for measurement.

4.2 Liquid for Immersion The liquid for immersion shall be the distilled water newly prepared or the distilled water boiled immediately before test to expel air.

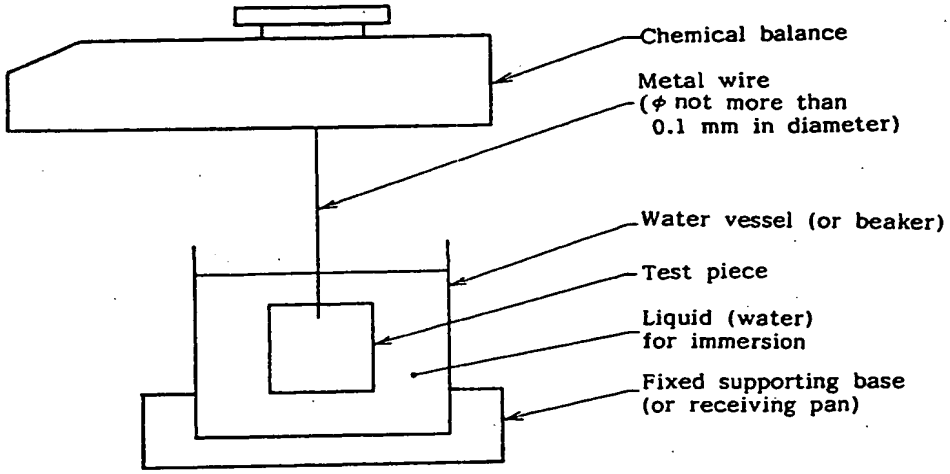
4.3 Testing Apparatus The following shall be used for testing apparatus (Refer to Fig. 1).

(1) Chemical balance Sensitivity 0.1 mg.

(2) Beaker or water vessel

(3) Fixed supporting base or receiving pan

Fig. 1. Example of Apparatus for Specific Gravity Test



4.4 Testing Method The testing method shall be the displacement method in water, and the procedures shall be as follows.

(1) Suspend a test piece to the arm of a chemical balance using a metal wire of 0.1 mm or less in diameter, and weigh accurately its mass in air to the nearest 0.1 mg.

(2) After putting the immersion liquid that has been made free from air in a beaker or water vessel, and place it on a fixed supporting base or receiving pan lest the water vessel should contact with the movable part of the balance.

(3) Immerse the test piece tied with metal wire in immersion liquid, and suspend other end of the wire to the arm of chemical balance.

(4) Expel completely the air bubbles attaching on the test piece using such as a thin metal wire, and then weigh its weight to the nearest 0.1 mg.

(5) Specific gravity shall be calculated according to the following formula:

$$S=\frac{a}{a-b}$$

where S: specific gravity

a: mass of test piece in air (g)

b: mass of test piece weighed under being suspended in water (g)

4.5 Presentation of Test Result Three test pieces shall be tested, and their average shall be used for the test results.

4.6 Record The following items shall be recorded on the test results.

(1) Specific gravity

(2) Temperature for testing

(3) Temperature of immersing liquid

(4) Other necessities

5. Tension Test

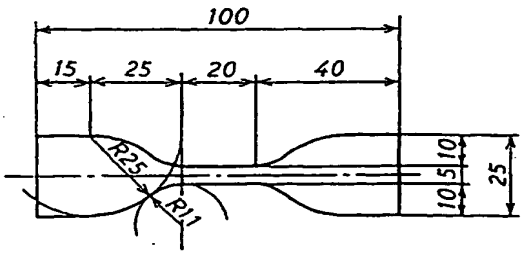
5.1 Test Piece

5.1.1 Shape and Dimension of Test Piece The test piece shall be dumbbell shape as shown in Fig. 2, and punched with an adequate punching die.

When punching, the longitudinal direction of a dumbbell-type test piece shall be in parallel with its flow direction of sample.

Fig. 2. Dumbbell-Type Test Piece

Unit: mm



5.1.2 Measurement of Thickness and Width The thickness and width of a test piece shall be measured as follows:

(1) A thickness tester shall be graduated to 0.01 mm and its pressurizing surface shall be smooth and a circular flat measuring 5 mm in diameter. The pressurizing load of this tester, principally, shall be 0.785 N {80 gf}, and not fluctuate not less than ± 15 % within a measuring range.

(2) Measure the thickness of a test piece at several points of parallel part, and adopt the minimum value out of the measured values as the thickness of the test piece. In this case, avoid such measurement as the center of pressurizing surface extrudes outside from the edge of the test piece.

(3) Use the width of the punching machine (inside width of cutter) as that of the test piece.

(4) Calculate the sectional area of a test piece by multiplying thickness (cm) by width of parallel part (cm).

5.1.3 Marked Line for Elongation Measurement The marked line for an elongation measurement, hereinafter referred to as the "marked line" shall be attached as follows.

(1) The gauge length (the distance between two marked lines) shall be 20 mm.

(2) The marked line shall be attached clearly and accurately on the parallel part of a test piece with making the center of the test piece coincide with the center of marks.

5.2 Testing Apparatus The testing apparatus shall be the tensile testing machine satisfying the following requirements:

5.2.1 Mechanism of Testing Machine The testing machine shall be equipped with an indicator for the maximum load and with the grips capable of fastening automatically a dumbbell-type test piece.

5.2.2 Capacity of Testing Machine The maximum load of the testing machine, when testing, shall fall within the range from 15 to 85 % of its capacity.

5.2.3 Tensile Speed The separation rate of the grips for a test piece, principally, shall be 0.0050 ± 0.0003 m per second {300 ± 15 mm per minute}.

5.2.4 Tolerance on Load Graduation of Testing Machine The tolerance on the load graduation of a testing machine shall be ± 2 %.

5.2.5 Inspection of Testing Machine The testing machine shall be installed accurately and be inspected once a year at least.

5.3 Test Method

5.3.1 Attaching of Test Piece A test piece shall be attached to the grips of the testing machine lest a distortion, cut by grasping, or other troubles should take place while testing is carried out.

5.3.2 Measurement of Tensile Strength and Elongation The tensile strength shall be obtained by measuring the maximum load shown until the test piece is broken using the testing apparatus of 5.2.

The elongation shall be obtained by measuring the distance between the marked lines, when breaking, to the nearest 1 mm by using a suitable method.

5.3.3 Measurement of Tensile Stress The tensile stress shall be defined as the stress exerted when a specified elongation is given to a test piece, and generally it is measured when given 100 % or more elongation. Due to a suitable method, the load given when the distance between the marked lines has reached a specified length, shall be read out.

5.3.4 Calculation The tensile strength, elongation, and tensile stress shall be calculated according to the following formula:

(1) Tensile strength

$$T_B = \frac{F_B}{A}$$

where T_B: tensile strength (MPa) {kgf/cm²}

F_B: maximum load (N) {kgf}

A: original cross-sectional area of test piece (cm²)

(2) Elongation

$$E_B = \frac{L_1 - L_0}{L_0} \times 100$$

where E_B: elongation (%)

L_0: distance between gauge length (mm)

L_1: distance between gauge length when breaking (mm)

(3) Tensile stress

$$M_n = \frac{F_n}{A}$$

where M_n(1): tensile stress (MPa) {kgf/cm²}

F_n: load given under specified elongation (N) {kgf}

A: original cross-sectional area of test piece (cm²)

Note (1) The suffix "n" in M_n means the percentage of specified elongation (%). For instance, M_{300} means the tensile stress measured at the elongation of 300 %.

5.4 Presentation of Test Results Principally, three test pieces shall be measured, and their average shall be used for test results.

5.5 Record The following items shall be recorded on the test results.

(1) Tensile strength (MPa) {kgf/cm²}, elongation (%), and tensile stress (MPa) {kgf/cm²}

(2) Model and capacity of the testing apparatus

(3) Other necessary items

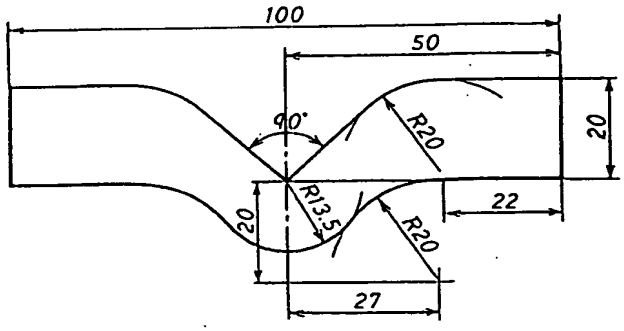
6. Tear Test

6.1 Test Piece

6.1.1 Shape and Dimension of a Test Piece The test piece for tear test shall be a rectangle-type as shown in Fig. 3, and be punched with an adequate punching machine. When punching, the longitudinal direction of a test piece shall be in parallel with its flow direction of sample.

Fig. 3. Rectangle-Type Test Piece for Tear Test

Unit: mm



6.1.2 Measurement of Thickness The thickness of notched part of a test piece shall be measured as in 5.1.2.

6.2 Testing Apparatus A testing apparatus shall be the tensile testing machine shown in 5.2. The separation rate of the grips for a test piece shall be 0.0050 ± 0.0003 m per second {300 ± 15 mm per minute}.

6.3 Test Method

6.3.1 Attaching of Test Piece A test piece shall be attached to the grips of the testing machine lest such troubles as a cut by grasping should take place while testing is carried out.

6.3.2 Operation Apply tensile load until the test piece is broken.

6.3.3 Calculation The tear strength shall be calculated according to the following formula:

$$T_R = \frac{F}{t}$$

where T_R: tear strength (kN/m) {kgf/cm}

F: maximum load (N) {kgf}

t: thickness of notched part of test piece (m) {cm}

6.4 Presentation of Test Results Principally, three test pieces shall be measured, and their average shall be used for the test results.

6.5 Record The following items shall be recorded on test results.

(1) Tear strength (kN/m) {kgf/cm}

(2) Model and capacity of a testing apparatus

(3) Other necessary items

7. Hardness Test

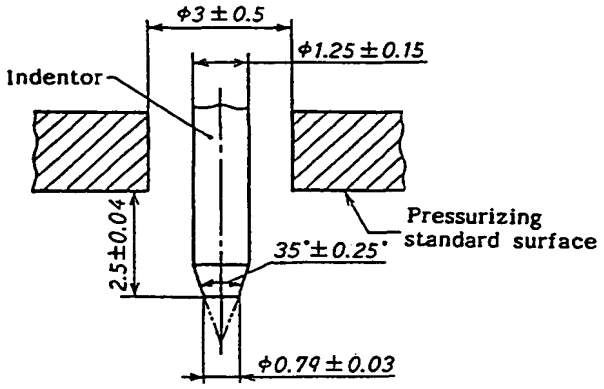
7.1 Test Piece The thickness of a test piece shall be prepared not less than 6 mm in order to make it free from, when being tested, any influence caused by other materials. In case of thinner than 6 mm, 6 mm should be made by piling up. The measuring surface of a test piece shall be flat, and its area shall be large enough to cover the pressurizing standard surface of a testing machine.

7.2 Testing machine The testing machine shall be Type A durometer specified in JIS K 7215. In the case where the hardness given by this testing machine is 95 or more, Type D durometer specified in JIS K 7215 shall be used. Fig. 4 gives the shape and dimensions of the indentor to be used in durometer.

Fig. 4. Shape and Demension of Indentor of Durometer

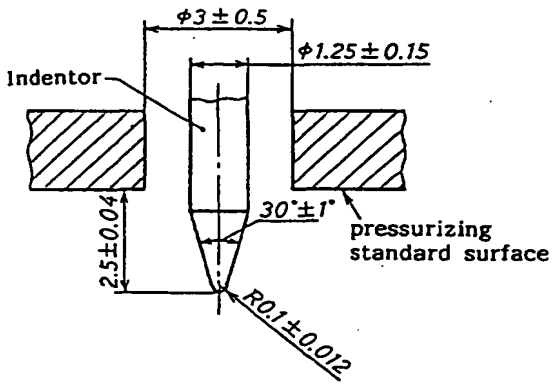
Indentor for Type A Durometer

Unit: mm



Indentor for Type D Durometer

Unit: mm



7.3 Testing Method Keeping the testing machine vertically, allow an indentor to contact rectangularly with the surface to be measured of the test piece, and apply the load of 9.8 N {1 kgf} on the test piece. Read the scale of the hardness tester immediately.

7.4 Presentation of Test Result Principally, five points shall be measured, and their average shall be used for the test results.

7.5 Record The following items shall be recorded on the test results.

(1) Hardness

(2) Type of a hardness testing machine

(3) Other necessary items

8. Impact Resilience Test

8.1 Test Piece The test piece, which measures 20 to 30 mm in length, 20 to 30 mm in width, and 10 to 15 mm in thickness, shall be used. In order to prepare the test piece of specified thickness, the test piece that has been piled up may be used.

8.2 Testing Apparatus

(1) The testing apparatus shall be the impact resilience testing machine constructed as shown in Fig. 5.

(2) An iron bar shall be the 350 g in mass round bar of about 356 mm in length and 12.7 mm in diameter, and its end for shock shall be made hemispherical type of 12.7 mm in diameter and other end shall have a pointer.

The iron bar is suspended horizontally with four fishlines, and its suspending height shall be 2000 mm and its vertical displacement shall be 100 mm when being dropped.

(3) The supporting device for a test piece shall be firmly assembled as shown in Fig. 6, and there shall be no apprehension as swinging owing to the impact by the iron bar. A scale plate shall measure 625 mm in horizontal length and 2000 mm in the radius of an arc, whose graduation is prepared by equally dividing 100 mm vertical distance by 100 parts.

(4) The testing machine shall be adjusted, when dangling freely the iron bar, so that the pointer may indicate at zero and the end for shock may touch just on the surface of a test piece.

Fig. 5. Example of Impact Resilience Testing Machine

Unit: mm

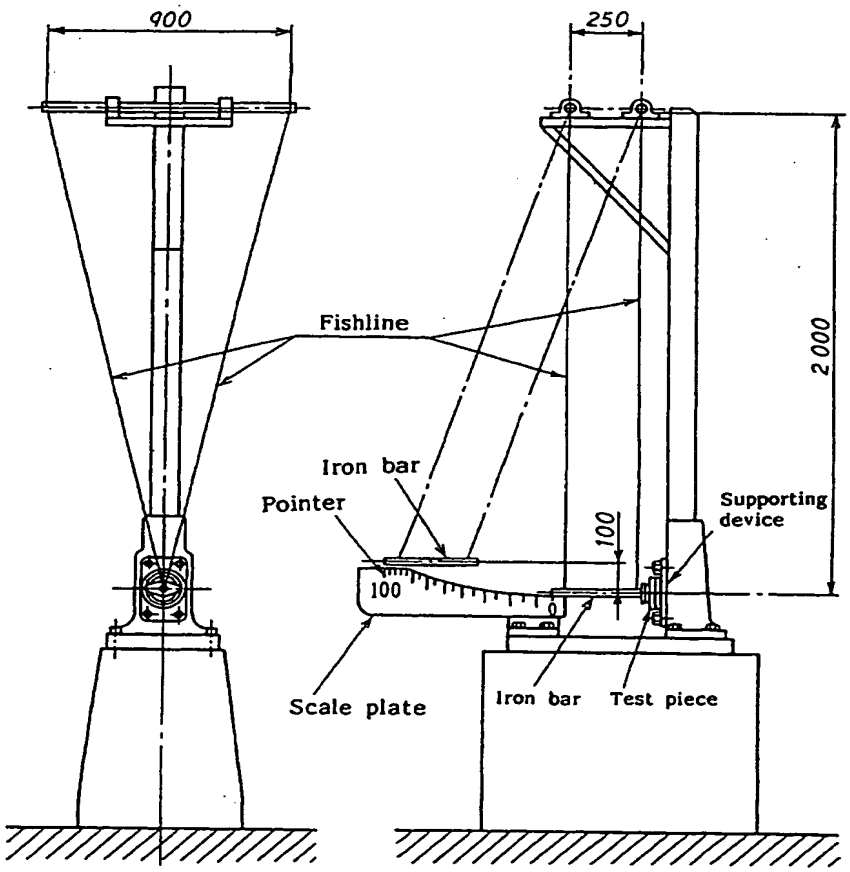
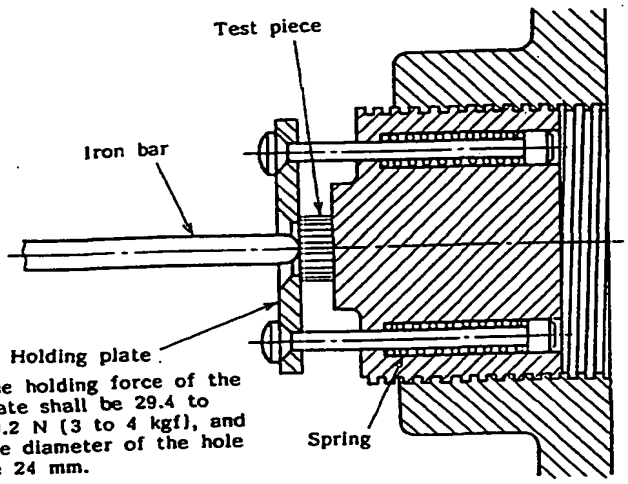


Fig. 6. Supporting Device of Test Piece



8.3 Test Method Coincide the pointer of the iron bar with the graduation of 100 on a scale plate, and after dropping freely the iron bar from this position, measure the graduation to which the bar has resiled. Repeating this operation, read the resilience height shown at the fourth trial, and make this resilience height the impact resilience (%).

8.4 Presentation of Test Result Principally, three test pieces shall be tested, and their average shall be used for the test result.

8.5 Record The following items shall be recorded on the test results.

(1) Impact resilience (%)

(2) Other necessary items

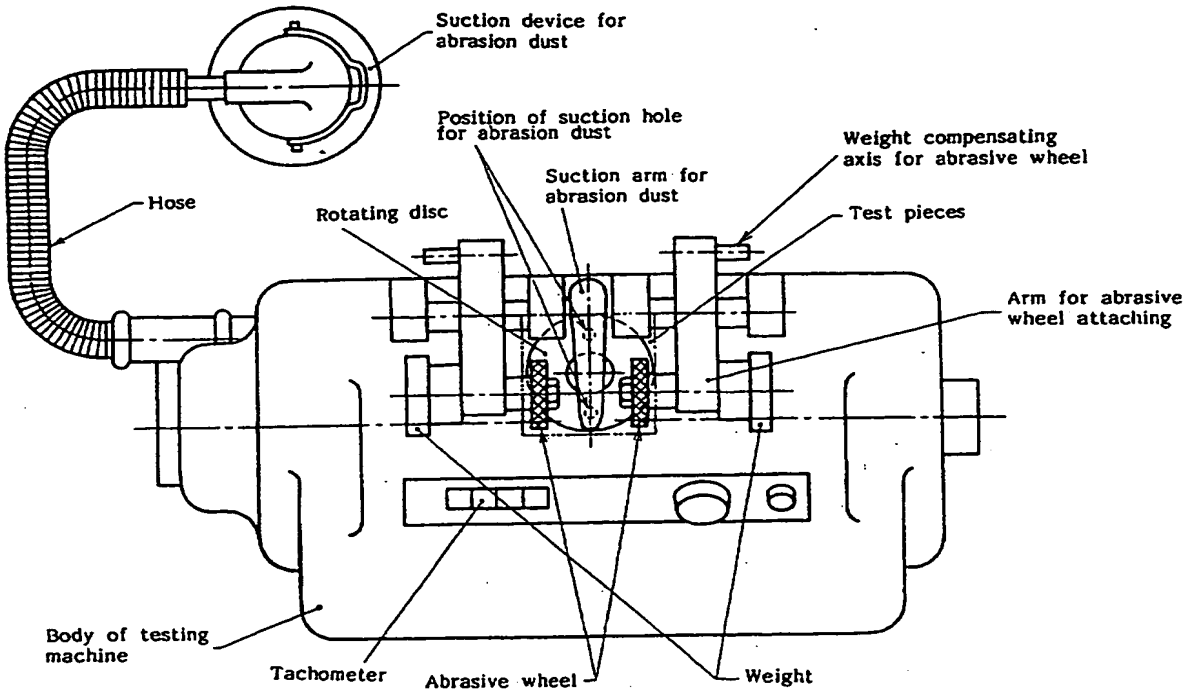
9. Abrasion Test

9.1 Test Piece A test piece shall be shaped as the disc measuring not less than 100 mm in diameter or as the shape giving no hindrance for testing, and shall be circularly punched 6.5 mm in diameter at its center.

Both surfaces of the test piece shall be parallel and smooth.

9.2 Testing Apparatus As shown in Fig. 7, a testing apparatus shall be the abrasion testing machine by which the test piece is worn using a pair of abrasive wheels pressed on the rotating test piece with specified load, and the testing machine shall meet the following conditions.

Fig. 7. Example of Abrasion Testing Machine



9.2.1 Dimensions and Accuracy of Main Parts

(1) Position of Attaching Abrasive Wheel to Rotating Disc As shown in Fig. 8, the distances L_1 and L_2 between the rotational center line of the rotating disc and each surface of attached abrasive wheels, and the distance l between the rotational center and the attachment center line of abrasive wheels, shall be decided as follows:

$$L_1 = L_2 = 39.4 \pm 0.3 \text{ mm}$$

$$l = 19.0 \pm 0.2 \text{ mm}$$

(2) Diameter of Axis for Attaching Abrasive Wheels The diameter of axis for attaching abrasive wheels shall be $15.87^{0}_{-0.03}$ mm.

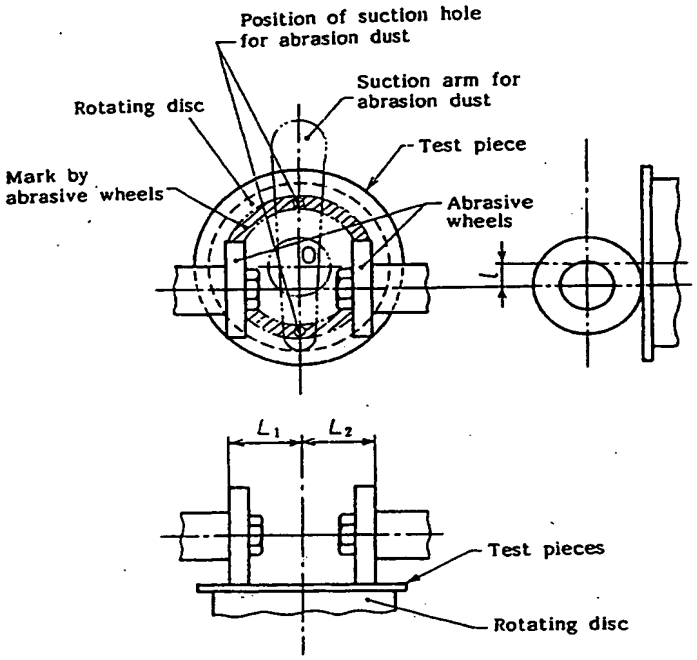
(3) Length of Attaching Arm for Abrasive Wheels The length of attaching arm for abrasive wheels (distance from a fulcrum to an action point) shall, be principally, 80 mm.

(4) Swinging of Rotating Disc The vertical swinging of the rotating disc shall be not more than ± 0.05 mm at the point apart 45 mm from the center (O).

(5) Inside Diameter and Position of Suction Hole for Abrasion Dust The inside diameter of suction hole for abrasion dust shall be of 8.0 ± 0.5 mm, and its position shall be as shown in Figs. 7 and 8.

9.2.2 Distance between Suction Hole of Abrasion Dust and Test Piece Attached to Rotating Disc The distance between the suction hole for abrasion dust and the test piece shall be 3 mm, and shall be adjusted using the thickness gauge specified in 9.2.6.

Fig. 8. Attaching Position of Abrasive Wheels



9.2.3 Rotating Rate of Disc The rotating rate of the disc shall be 60 ± 2 min^{-1} {60 ± 2 rpm}.

9.2.4 Load The load to be applied on the test piece shall be 9.8 N {1000 gf}.

9.2.5 Volume of Air Flow for Sucking Abrasion Dust The volume of air flow (Q) for sucking abrasion dust shall be Q = 0.5 ± 0.1 m^3/min under the condition of 3 mm distance between the suction hole specified in 9.2.2 and the test piece.

9.2.6 Accessories

(1) Suction Apparatus for Abrasion Dust The suction apparatus for abrasion dust shall be the device to suck in the abrasion dust produced from the test piece and abrasive wheels while testing, and shall be connected with the testing machine proper by using a hose as shown in Fig. 7.

(2) Weight Two pieces of weights, each of which weighs 750 ± 1 g, shall be prepared.

(3) Thickness Gauge The thickness of the thickness gauge shall be 3.0 ± 0.2 mm.

(4) Diamond Dresser A diamond dresser is a tool to dress the outer circumference of abrasive wheels, and is used for not only removing loading due to dust but also surface finishing to let the abrasive wheels press rectangularly the test piece.

9.2.7 Abrasive Wheels Principally, H-22 of abrasive wheel shall be used. In this case, other abrasive wheel may be used according to the agreement between the parties concerned.

9.3 Testing Method

9.3.1 Preparatory Wearing Repeat preparatory wearing according to the following, and when the mass difference given by successive two preparatory wearings falls within 20 percents, the test shall be carried out.

(1) Weigh accurately the mass of a test piece to the nearest 1 mg.

(2) Attach the test piece to the rotating disc of the testing machine.

(3) After dressing the outer circumference of abrasive wheels with a diamond dresser, fit them into the attaching axes for the wheels to fix them with fastening screws. Attach a couple of weights.
Available limit of abrasive wheels shall be until outside diameter wears to 45 mm.

(4) Lower quietly the suction arm for abrasion dust on the test piece, and adjust the distance between the test piece and the suction hole for abrasion dust to become 3 mm.

(5) Lower quietly the abrasive wheels on the test piece, and drive the testing machine and suction apparatus for abrasion dust.

(6) Carry out successive 100 rotations of abrasion for preparatory wearing.

(7) After demounting the test piece from the testing machine, take away alien matter such as abrasion dust from the test piece with a clean cloth, and weigh accurately the mass of the test piece to the nearest 1 mg. Obtain the preparatory abrasion loss from the difference between the mass of this time and the mass weighed in (1).

9.3.2 Test Carry out the test as follows:

(1) Weigh the mass of the test piece after preparatory wearing to the nearest 1 mg, and take this weight as the pretest mass.

(2) After operations in (2) to (5) of 9.3.1, carry out successive abrasion of 1000 rotations.

(3) After demounting the test piece from the testing machine, take away alien matter such as abrasion dust from the test piece using a clean cloth, and weigh accurately the mass of the test piece to the nearest 1 mg. Obtain the abrasion loss from the difference between the mass of this time and the pretest mass.

9.3.3 Presentation of Test Result Three test pieces shall be tested, and their average shall be used for the test result.

9.4 Record The following items shall be recorded on the test results:

(1) Abrasion loss (mg)

(2) Type of abrasive wheels

(3) Other necessary items

10. Flow Test

10.1 Test

10.1.1 Form of Sample Principally, samples shall be pelleted. In this case, however, if they can be filled up into a cylinder hole, any form such as powdery, granular, lumpy, or filmy may be used.

10.1.2 Conditioning of Sample The sample shall be satisfactorily dried up before testing.

10.2 Testing Apparatus

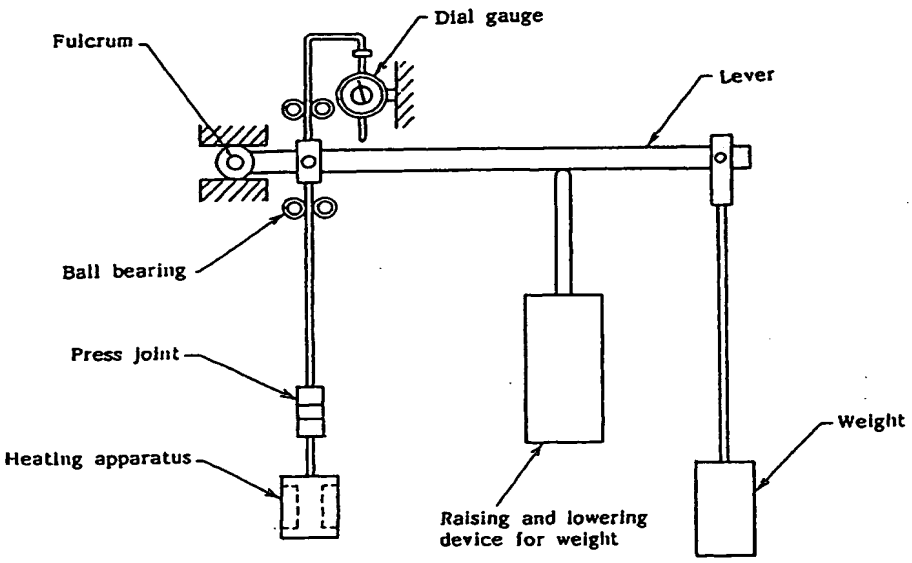
10.2.1 Testing Machine The testing machine is basically, as shown in Fig. 9, composed of a heating apparatus to heat the sample and of a flow tester equipped with a piston to pressurize the sample to specified value and with a die to let the sample flow out, and shall conform to the following requirements.

(1) Heating Apparatus The heating apparatus is equipped with a cylinder, the place for die insertion, heater for heating sample, and the regulator to control heating temperature.

(2) Cylinder The cylinder shall be made of metal measuring 60 mm in outside diameter and 71 mm in length, and have a sample inserting hole measuring $11.329\ ^{+0.005}_{0}$ mm in diameter and 41 mm in length and a thermometer inserting hole for reading the temperature of the cylinder near the die or a built-in temperature detector. At the bottom of the hole for sample insertion, a fixing metal part is fixed for holding the die.

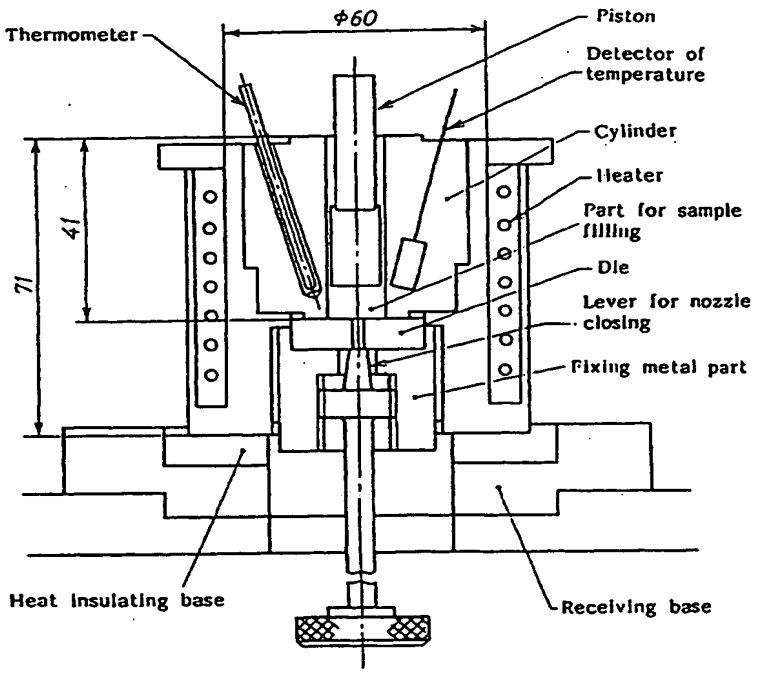
(3) Die The die inserted in the bottom of the hole for sample filling of cylinder shall be made of metal, and, principally, the shape and dimension of the die shall be as shown in Fig. 10. Its surface shall be finished by lapping.

Fig. 9. Example of Flow Tester



Details of Heating Apparatus

Unit: mm



Enlarged Figure of Cylinder and Die Part

Unit: mm

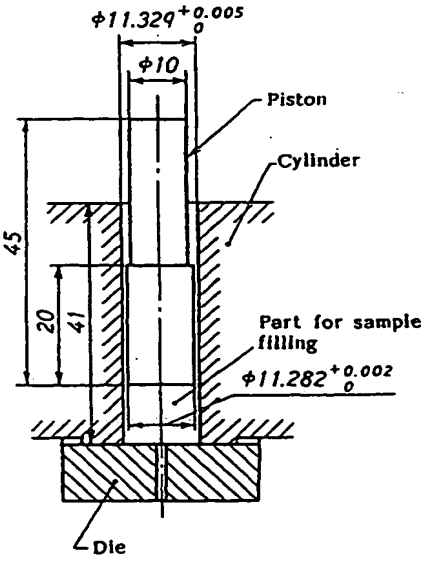
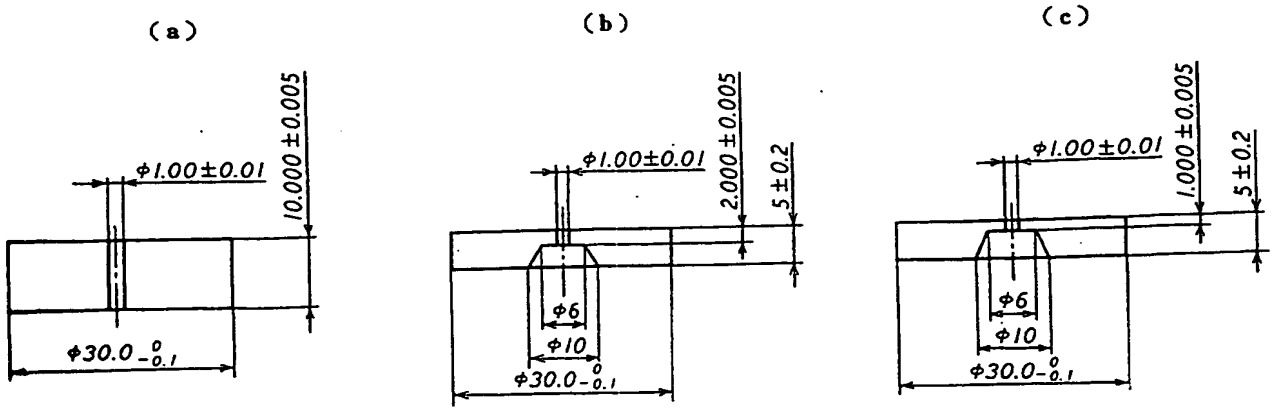


Fig. 10. Types of Die

Unit: mm



(4) Piston The piston, made of metal, shall measure 45 mm in total length, $11.282^{+0.002}_{0}$ mm in diameter of its head, and 20 mm in length, and its surface shall be finished by lapping. The diameter of the part upper than the piston head shall be 10 mm.

(5) Pressure The pressure applied to the piston shall be 98.07 to 490.3 N {10 to 50 kgf}, and the accuracy for setting testing load shall be within ± 1.0 % relative to the setting value.

(6) Heating Apparatus and Temperature Controlling Device The heating apparatus shall be capable of controlling the cylinder temperature necessary for testing in the range from 100 to 300°C by means of adequate heating method, and the temperature controlling device shall be capable of controlling by ± 0.5°C at the place up to 10 mm from the die upper surface.

(7) Thermometer The thermometer used in the apparatus shall be for measuring cylinder temperature near the die, and shall be a mercury thermometer or temperature detector that are readable to the nearest 0.5°C. The correction on the temperature referred to the test shall be carried out in advance as follows:

Fill the sample in a cylinder, and, when the thermometer shows the temperature of testing, the thermometer for correction shall be inserted directly into the sample to measure the sample temperature. Correcting the reading of the thermometer for apparatus making use of the difference between the thermometers for correction and for apparatus, adjust the temperature of a cylinder so that the corrected reading may become the testing temperature.

(8) Recording Device of Piston Lowering The apparatus shall be equipped with the device to record the lowering of a piston. Recording device shall record a functional relation between time and the amount of sample flowing out through a die (which is given by the lowering of the piston with a specified sectional area).

10.2.2 Devices for Test The following shall be used as the devices for test:

(1) Device for filling the sample into a cylinder

(2) Device for cleaning the cylinder

(3) Stop watch

(4) Chemical balance

(5) Thermometer for correction capable of measuring accurately to 0.1°C.

10.3 Test Method

10.3.1 Testing Conditions The temperature and the load for test shall be selected, principally, among the testing conditions for flow test shown in Table 2. The die shall be selected from Fig. 10 according to 10.2.1(3).

Table 2. Testing Conditions for Flow Test

Condition	Temperature for test °C	Load for test N {kgf}
1	150	98.07 {10.00}
2		490.3 {50.00}
3	160	98.07 {10.00}
4		490.3 {50.00}
5	170	98.07 {10.00}
6		490.3 {50.00}
7	180	98.07 {10.00}
8		294.2 {30.00}
9		490.3 {50.00}
10	190	98.07 {10.00}
11		294.2 {30.00}
12		490.3 {50.00}
13	200	98.07 {10.00}
14		294.2 {30.00}
15		490.3 {50.00}
16	210	98.07 {10.00}
17		294.2 {30.00}
18		490.3 {50.00}
19	220	98.07 {10.00}
20		294.2 {30.00}
21		490.3 {50.00}
22	230	98.07 {10.00}
23		490.3 {50.00}

10.3.2 Operation The operation for the test shall be as follows:

(1) After cleaning the apparatus, maintain the apparatus at the specified temperature for 2 min at least under the condition as the piston and die are attached.

(2) Weigh out 2 g of the sample into the cylinder (2), and, after putting the piston on, fix firmly the press joint. Finish this operation to fill up the sample within 1 min. At the instant finishing this filling, start the preheating, and the measurement of time, too.

Note (2) While the sample is being filled, the piston is put on the heating device to prevent it from cooling down.

(3) After 4 min from preheating (3), apply the load for test through the piston, and draw the flowing curve by plotting the lowering of the piston as the function of flowing time (4).

Notes (3) Within this time interval, the apparatus shall recover the temperature specified previously.

(4) Recording device shall be started earlier than the load applying by about 10 sec.

10.3.3 Calculation Flow value shall be calculated from the gradient of the flowing curve according to the following formula:

$$Q = 0.4/t$$

where Q : flow value (cm^3/s)

t : average of the time intervals needed for piston lowering from 3 mm to 7 mm after starting flowing due to the load for test (s)

10.4 Presentation of Test Result Principally, this test shall be repeated three times, and their average shall be used for expressing the test result.

10.5 Record The following items shall be recorded on the test results.

(1) Flow value (cm^3/s)

(2) Temperature and load for test

(3) Type of die

(4) Other necessary items

Normative references:

JIS K 7100-Standard Atmospheres for Conditioning and Testing of Plastics

JIS K 7215-Testing Methods for Durometer Hardness for Plastics

JIS Z 8401-Rules for Rounding off of Numerical Values

Related Standards:

JIS K 6250-General Rules of Physical Testing Methods for Vulcanized Rubber

JIS K 7112-Methods for Determining the Density and Specific Gravity of Plastics

JIS K 7204-Testing Method for Abrasion Resistance of Plastics by Abrasive Wheels

JIS K 7210-Testing Method for Melt Flow Rate of Thermoplastics

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